SPFO reports

Forest Insect & Disease Management

Evaluation Report

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OCCURRENCE OF ECTOMYCORRHIZAL FUNGUS ON WHITE SPRUCE AT EVELETH AND TOUMEY USFS NURSERIES

by

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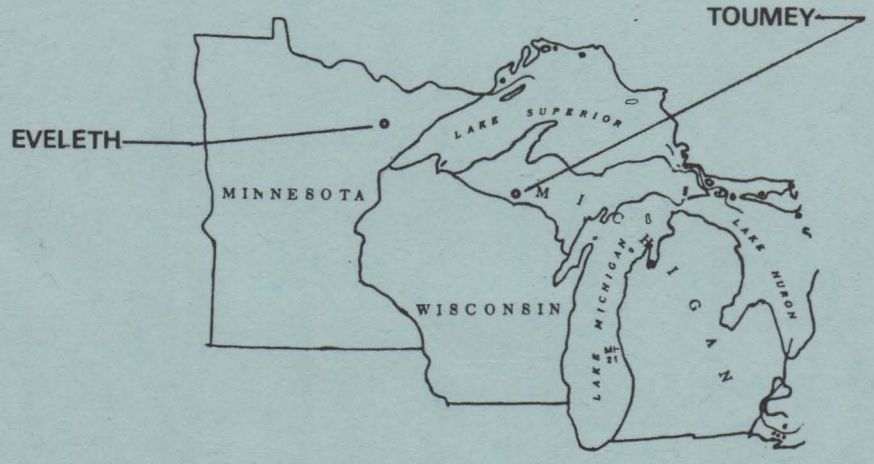

NORTHEASTERN AREA, STATE & PRIVATE FORESTRY
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INTRODUCTION

During 1976, the Director of Timber Management, Region 9, USDA Forest Service, requested that S&PF, FI&DM evaluate the occurrence of ectomycorrhizae on white spruce seedlings at Toumey (Watersmeet, Michigan) and Eveleth (Eveleth, Minnesota) National Forest Nurseries. This evaluation was needed because of the lack of information about mycorrhizal fungi on white spruce at both nurseries. Studies have shown that proper ectomycorrhizal fungus on conifer roots will increase the surface area of the roots, increase root longevity, aid in absorbing soil bound nutrients, increase growth, and increase tolerance to stress, with a resulting increase in seedling survival. Ectomycorrhizal fungi also provide protection against certain soil pathogens.

OBJECTIVES

The purpose of this survey was to determine the percentage of ectomycorrhizal feeder roots on 1-0, 2-0 and 3-0 [1/] white spruce seedlings and to analyze possible soil fertility associations.

METHODS

Forty seedlings were lifted from each of two beds for each of the three age classes at each nursery. Soil samples were collected at each lifting site, brought to the University of Minnesota soil laboratory and analyzed for pH, P and K. The seedlings were placed in plastic bags and transported to the laboratory at St. Paul. The root systems were examined using sequential sampling. Twenty nonmycorrhizal and 20 mycorrhizal cataloged feeder roots were examined for the formation of Hartig Net and mantle.

The following data were recorded for each seedling:

1. Total number of feeder roots examined.
2. Number of feeder roots with mycorrhizal fungi.
3. Percentage of each root system that was infected.
4. Crown length.

RESULTS AND DISCUSSION

Some ectomycorrhizal fungi were present on every seedling examined. The percentages are summarized in Table 1. Due to lack of studies on mycorrhizae in white spruce, the optimum ectomycorrhizal percentage for nursery grown white spruce is unknown. If white spruce follows the same patterns as other conifers studied, then the percentages are near an acceptable level at Eveleth and are too low at Toumey. Soil fertility data were collected at both nurseries. The data are summarized in Table 2. Comparison of the fertility rates indicates that the more potassium at Eveleth encourages ectomycorrhizal fungus development. Other surveys at the Eveleth Nursery indicate a combination of cultural practices is causing the difference and that one factor such as potassium is not the controlling factor.

[1/] (1-0) The first number is the years in the seedling bed and the second number is the years in a transplant bed.

The 1-0 seedlings at Eveleth were smaller than those at Toumey. The 3-0 seedlings at Eveleth were approximately 40mm higher than those from Toumey (Table 3). The percentage of mycorrhizal feeder roots was about 35 percent better at Eveleth in the 3-0 stock.

CONCLUSION

The following conclusions are based on results from the root systems examined:

1. Although mycorrhizae were found on all trees examined, the percentage of mycorrhizal feeder roots appears to be too low for maximum tree benefit at both nurseries.
2. The percentage of mycorrhizal feeder roots per seedling increased with age at Eveleth and remained constant at Toumey.
3. The phosphorus levels and pH values in the soil appears to be approximately the same for both nurseries. The potassium levels are substantially higher at Eveleth.
4. The reason for the difference in ectomycorrhizae development between the two nurseries is unknown.
5. The height growth response suggests that increased ectomycorrhizal fungi produced taller seedlings.

RECOMMENDATIONS

We recommend that a meeting be held between S&PF, R9, and NCFES to discuss the possible cause-effect relationships and the need for future S&PF evaluations and research by NCFES.*

* The data available seems to be sufficient to support a recommendation for NCFES to conduct investigation to determine the optimum ectomycorrhizal fungus infections needed for nursery grown white spruce, and to determine the effects of nursery cultural practices on ectomycorrhizal fungus development on white spruce seedlings.

Table 1.--Percentage of mycorrhizal feeder roots on 1-0, 2-0 and 3-0 white spruce seedlings at Toumey and Eveleth National Forest Nurseries, 1976

Seedling Age	Eveleth		Toumey	
	Mean	$SE_{\bar{x}}$	Mean	$SE_{\bar{x}}$
1-0	15.7±	0.7	15.1±	0.7
2-0	30.3±	0.9	17.0±	0.5
3-0	45.9±	1.1	10.7±	0.8

Table 2.--Soil analysis of 1-0, 2-0 and 3-0 white spruce seedling beds at Eveleth and Toumey National Forest Nurseries, 1976

Seedling Age	Eveleth			Toumey		
	pH	P lbs/ac	K lbs/ac	pH	P lbs/ac	K lbs/ac
1-0	6.3	200	420	5.7	146	140
2-0	5.6	200	200	6.0	200	170
3-0	6.5	200	230	6.0	200	150

Table 3.--Crown height of 1-0, 2-0 and 3-0 white spruce seedlings at Toumey and Eveleth National Forest Nurseries, 1976

Seedling Age	Eveleth			Toumey		
	Mean	$SE_{\bar{x}}$	SD	Mean	$SE_{\bar{x}}$	SD
1-0	16.4±	1.4	6.4	37.3±	2	9
2-0	124.0±	8.5	37.9	123.2±	5.2	33
3-0	253.2±	9.6	42.8	213.8±	10.8	48.7